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GRAPHICS WORKSTATIONS

AND THE

REAL-TIME TELEMETRY PROCESSING SYSTEM

William R. Hummel

ABSTRACT

The requirement for more real-time capabilities on the part of major test programs such as the F18 E/F and V-22 has prompted the Telemetry Division at the Naval Air Warfare Center - Aircraft Division, Patuxent River, Maryland to undertake its first major upgrade since the Real-time Telemetry Processing System III (RTPS) was placed in operation in May 1988. The state of the art in graphics workstations offers vastly superior performance at a comparatively low price and in a very small package. The Telemetry Division has begun the process of adding workstations to the RTPS III in order to fully support future test programs and extend the life of the system.

INTRODUCTION

The Real-time Telemetry Processing System (RTPS) serves as the central ground station for flight testing at Patuxent River. It consists of six identically configured subsystems, referred to as "streams", and a seventh subsystem which serves as a file system. Each stream can handle a flight test independent of the other streams. Flight tests are conducted by customer personnel from the six Project Engineer Stations (PES).

Each PES is configured with numerous display and output devices. 80 channels of strip chart data are available. There are 32 numeric display panels mounted in four enclosures suspended from the ceiling. A laser printer provides general purpose report capability. There are several color terminals providing limit checking reports and interactive capability. Graphics capabilities are provided by two Adage 4145 vector refresh display systems and two PsiTech 800 monitors.

Each Adage system is configured with a 23" round monochrome monitor, alphanumeric keyboard, function keyboard and a laser printer for hard copying images. The Adage systems serve as operator interaction points as well as providing generic plotting and custom graphics. Plots are prepackaged for ease of use. They provide from one to four grids per screen and up to 16 screens may be defined to collect data concurrently. Data is available at up to 500 samples per second per measurement. All plot data received is saved and is available to be re-plotted as desired. Graphics displays are tailored to the needs of each project, providing three dimensional data driven models, alphanumeric data readouts, and general data presentation capabilities. Data to the Adage from the host Encore 32/67 is via Encore's High Speed Data (HSD) and Adage Graphics Interface (AGI).

The PsiTech 800 displays are 19" color raster scan devices with programmable graphics capability. There are prepackaged tabular data and bar graph displays to which the user can assign any telemetry or calculated measurements. These are automatically updated every second once initiated by the user. Displays can also be customized for a particular project. Color hard copy devices are provided for each PsiTech. The interface from the host Encore 32/67 is an RS232 serial link running at 19,200 baud.

MOTIVATIONS FOR ADDING WORKSTATIONS

There are several reasons for pursuing new graphics capability. Flexibility and ease of programming is a key factor. The Adage must be programmed via a cross compiler that runs on the host Encore computer. The resulting display image must be downloaded from the host to be tested. Even more cumbersome is the fact that the Adage can only run one display image at a time. Thus multiple uses such as operator interaction, header time and data, and project specific graphics must be pre-linked and downloaded all at once. It also means that plots and graphics cannot be run together on a single Adage. And even more limiting is the fact that generic features that are contained in project specific images cannot be changed without giving up compatibility. Additionally, the data path is relatively inflexible, i.e. measurement routing must be predefined. The PsiTech displays are even less flexible and are more cumbersome to program, requiring unique commands which must be compiled and downloaded.

In addition, there is considerable interest in real-time capabilities which cannot be supported with the existing RTPS configuration. These include general data capture for intermaneuver recall and processing, and data interaction techniques currently only available post-flight at the flight test engineer's office. Also, the possibilities for providing workstation compatible data collection media for post-flight use will be explored.

WORKSTATION DESCRIPTION

The workstations to be installed in each PES are Silicon Graphics Indigo 2 Extreme. Each is configured with a 19" color monitor, 1.0 GB hard drive, 3.5" floppy disk drive, CD-ROM drive, 1/4" tape drive, mouse and 32 MB RAM. Features include EISA bus, Ethernet, Centronics parallel port, and SCSI 2. Software features include IRIX (Silicon Graphics implementation of UNIX), C compiler, the IRIS Graphics Library (GL), X Window System, and Motif. The first six workstations have an R4000 CPU. The second six have an R4400 CPU. The second six have an additional 32 MB of RAM.

SYSTEM INTERFACE

The primary data interface between the Encore host system and the SGI workstation is Systran's SCRAMNet. It consists of a memory interface board installed on the Encore 32/97 SelBus which captures real-time data and replicates it via fiber optic cable into a SCRAMnet board installed on the EISA bus. This interface provides all current value table (CVT) measurements both telemetered and calculated to the workstation. This interface is transparent to the Encore host and has no impact on the existing features and capabilities of the stream.

The built-in Ethernet capability of the workstation will be utilized for data and/or file exchange with other workstations within the stream.

INSTALLATION STATUS

Our integration schedule calls for installation to begin in April 1995 Initial project use will begin in June of 1995. All six RTPS Project Engineer Stations will be fully configured with two workstations mounted in the two display consoles by January 1996.

The initial operating capability for the workstations provides full access of current value table data to applications.

SHORT TERM PLANS

After an initial period of operating the workstations as a supplement to the existing capabilities, plans call for phasing out the PsiTech color raster scan displays. This will involve providing an upwardly compatible functionality on the workstations. Currently this includes the tabular and bar graphs mentioned earlier and project specific displays such as limit checking reports. Follow-on capability will include providing data in a "time series" form with which consecutive samples of data can be processed. In addition, electronic print files and hard copy record of displayed information is planned. Video recording of displays is also under investigation.

KNOWN PROJECT REQUIREMENTS

The first project to use the workstation is F14D Digital Flight Controls. Three display types are being developed. One is a variation on an existing RTPS display which includes a three dimensional image of the aircraft and graphical representation of basic aircraft parameters, aircraft control positions, and graphical representation of several pilot controls (stick, pedal, throttle). The aircraft image is driven by pitch, roll and heading data. A second display provides a visual status indication of several aircraft systems. It consists of a series of colored boxes with labels. Color changes are used to indicate a particular condition such as a failure or activation. The third display is called the Fault Indication Table. It is used to monitor the health of the six onboard computers. It uses color to represent a bit on/off condition.

A major factor in the push for workstations is the next large test program to come to Pax River, the F18 E/F, due here in early 1996. This program will exploit the additional display capability in a variety of ways.

A new type of display will show aircraft subsystem schematics overlaid with current measurement data values at meaningful locations. This will significantly heighten the engineer's situational awareness. One example is fuel management where an overlay of the fuel system would be displayed and within each tank the digital value of each fuel quantity would update real-time. Other possibilities include hydraulics, electrical, surface positions, emergency systems.

Existing flutter plots will be rehosted and enhanced for the workstation. The current frequency response function and frequemncy vs. amplitude plots will have an interactive feature added which was not possible with the Adage display. Additionally, three dimensional presentation of the spectral output will be possible for the first time.

TELEMETRY DATA SERVER

Development has begun on a new capability for Pax River whereby the flight test engineer will have access to telemetry data in the same

manner both during the flight and back at the office afterwards. The SGI workstation will play an integral role in this process as the data capture and in-flight review point. The data will be moved to a Telemetry Data Server computer where it will be immediately accessible to the flight test community via the base-wide network. This will allow the engineer to review the data and select subsets for further processing or download to the desktop computer.

The data for the Telemetry Data Server is provided such that each sample as it is received from any of the five telemetry sources is tagged with an identifier and stored sequentially in the workstation memory via Scramnet. It is then stored onto a high capacity removable disk drive. Time samples are interspersed with the data at millisecond intervals.

This capability will dramatically reduce turnaround time and for the first time data from a morning flight can be reviewed at the office in time to fly again that afternoon.

Data review applications will be developed so as to be usable during the flight on the real-time SGI workstation identically with its use afterwards when signed on to the Telemetry Data Server from a desktop computer.

CONCLUSION

This first major upgrade to the RTPS III will provide new real-time capabilities. It will be a first step toward extending the life of the system by introducing new technology while retaining compatibility with existing capabilities. The workstations will also provide capabilities familiar to those who do extensive hands-on processing at the office which will hopefully stimulate new thinking as to what can be accomplished during the flight.